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International application number: PCT/US2004/037345

International filing date: 08 November 2004 (08.11.2004)

Document type: Certified copy of priority document

Document details: Country/Office: US
Number: 60/537,774
Filing date: 20 January 2004 (20.01.2004)

Date of receipt at the International Bureau: 06 January 2005 (06.01.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

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APPLICATION NUMBER: *60/537,774*
FILING DATE: *January 20, 2004*
RELATED PCT APPLICATION NUMBER: *PCT/US04/37345*

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This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
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☐ *Additional inventors are being named on th____ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (280 characters max)

MATERIAL PUMP

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification *Number of Pages*	6	☐ CD(s), Number	
☒ Drawing(s) *Number of Sheets*	2	☐ Other (specify)	
☐ Application Data Sheet. See 37 CFR 1.76			

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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

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Respectfully submitted,

SIGNATURE *Richard D. Conard*

Date 01/19/2004

TYPED or PRINTED NAME Richard D. Conard

REGISTRATION NO. *(if appropriate)* 27321

Docket Number: 3030-73881

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Invention: MATERIAL PUMP

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3030-73881
ITW-14408.99

MATERIAL PUMP

Field of the Invention

This invention relates to material pumps. It is disclosed in the context of a pump for pumping, for example, coating material (hereinafter sometimes paint), but is believed to be useful in other applications as well.

Background of the Invention

Various types of material pumps are known. There are, for example, the pumps illustrated and described in U. S. Patents: 4,009,971; 4,397,610; 5,094,596; 5,220,259; 5,228,842; 5,336,063; 5,632,816; 5,725,150; 5,725,358; 5,746,831; 5,787,928; 5,944,045; and, 6,533,488, and references cited therein. There are also systems such as, for example, the Ransburg E-Z Flow system, and Binks A41-78-R3 EXEL™ Pump Series Binks®, ITW Industrial Finishing, 2002. There are also the disclosures of U. S. S. N. 10/232,454, filed August 30, 2002, titled Multiple Component Metering And Dispensing System, and U. S. S. N. 10/254,121, filed September 25, 2002, titled Two-Component Spray Gun With Solvent Flush/Blend, both assigned to the same assignee as this application. The disclosures of these references are hereby incorporated herein by reference. This listing is not intended to be a representation that a complete search of all relevant art has been made, or that no more pertinent art than that listed exists, or that the listed art is material to patentability. Nor should any such representation be inferred.

Disclosure of the Invention

According to the invention, an assembly includes multiple fluid pumps. Each pump includes a movable component and a crank coupled to the movable component. At least two of the movable components define between them a non-zero included angle so that their respective pumps are driven out of phase with each other.

Illustratively according to the invention, the crank comprises at least two throws. The apparatus further includes at least two connecting rods. The crank is coupled to the movable component by the at least two throws and the at least two connecting rods.

Illustratively according to the invention, the at least two throws comprise

at least three throws. One of the at least three throws defines substantially equal included angles with the other two of the at least three throws.

Illustratively according to the invention, the at least three throws comprise n throws, n an integer greater than 2, each throw making included angles with two others of the n throws, each said included angle being about 360°/n.

Alternatively or additionally illustratively according to the invention, the crank comprises a cam. The apparatus further includes at least two followers. The crank is coupled to the movable component by the cam and the at least two followers.

Illustratively according to this aspect of the invention, the cam is configured to drive at least two of the pumps such that one of the at least two pumps reaches the beginning of an exhaust stroke at substantially the same time that the other of the at least two pumps reaches the beginning of a priming stroke.

Illustratively according to this aspect of the invention, the cam comprises m cams, where m is an integer greater than or equal to 2. Each cam includes p lobes, where p is an integer greater than or equal to 2. The lobes are provided on the m cams so that a line drawn between peaks of two adjacent lobes of one of the m cams makes non-zero angles with lines drawn between peaks of any two adjacent lobes of another of the m cams.

Brief Description of the Drawings

The invention may best be understood by referring to the following detailed description and accompanying drawings which illustrate the invention. In the drawings:

Fig. 1 illustrates a partly fragmentary, partly sectional side elevational view of a composite pump constructed according to the invention; and,

Fig. 2 illustrates an end elevational view of another composite pump constructed according to the invention.

Detailed Descriptions of Illustrative Embodiments

The fluid output pressure from certain positive displacement pumps, such as reciprocating piston type fluid pumps, typically exhibits pressure pulses. An example of such pumps is a four ball pump of the type illustrated in, for example, Binks® A41-78-R3 EXEL™ Pump Series Binks®, ITW Industrial Finishing, 2002. In such a pump, as

the pistons reverse directions, there is a negative-going pulse in the output fluid pressure. Although other types of pumps, such as rotary pumps and the like provide a steadier flow with fewer and/or less dramatic changes in output fluid pressure, most such pumps expose the fluids they pump to considerable shear stress. In many applications, such as, for example, the pumping of certain coating materials which are continuously circulated in a coating material circuit, exposure of the recirculating coating material to high shear can adversely affect the coating material's recirculation life.

Referring now particularly to Fig. 1, a composite pump 20 constructed according to the invention includes multiple fluid pump sections 20-1, 20-2, . . . 20-n, only one of which is illustrated. Typically, the components of the composite pump are supported in a frame 21. Each pump section 20-1, 20-2, . . . 20-n includes an operating rod 22-1, 22-2, . . . 22-n, respectively. The pump 20 further includes a crankshaft 24 rotatably mounted in suitable bearings. Crankshaft 24 has throws 24-1, 24-2, . . . 24-n. Operating rods 22-1, 22-2, . . . 22-n of pump sections 20-1, 20-2, . . . 20-n, respectively, are coupled by connecting rods 26-1, 26-2, . . . 26-n, respectively, to throws 24-1, 24-2, . . . 24-n, respectively.

When viewed from an end 28 of crankshaft 24, the throws 24-1, 24-2, . . . 24-n illustratively make equal angles with adjacent throws 24-1, 24-2, . . . 24-n. It should be understood, however, that throw 24-1 need not be offset by equal angles between throw 24-2 and 24-n. Indeed, throw 24-m and throw 24-(m - 1) or 24-(m + 1), $1 \leq m \leq n$, could make angles of 180° with respect to each other. It simply means that throw 24-m lies at equal angles between some two of the remaining throws 24-1, 24-2, . . . 24-(m - 1), 24-(m + 1), . . . 24-n. It should further be understood that it is not necessary for throws to be offset at equal angles from each other. For example, the invention may be practiced using a crankshaft having only two throws which are angularly offset from each other by, for example, 90°.

The pistons of pump sections 20-1, 20-2, . . . 20-n are driven out of phase to provide a supply of the fluid which has reduced pumping pressure pulses. Any angular orientation in which one of the pump sections 24-1, 24-2, . . . 24-n is not to be at the end of a pumping stroke when another of the pump sections 24-1, 24-2, . . . 24-n reaches the end of its pumping stroke and begins its priming or intake stroke will reduce the negative-going pulse, thereby smoothing the flow of the pumped fluid. The crankshaft 24 illustratively is driven by an AC motor 36 through a right angle gearbox 38.

In another embodiment of the invention illustrated in Fig. 2, a composite pump 120 constructed according to the invention includes multiple fluid pump sections 120-1, 120-2, . . . 120-n supported in a frame 121. Each pump section 120-1, 120-2, . . . 120-n includes an operating rod 122-1, 122-2, . . . 122-n, respectively. The pump 120 further includes a crankshaft 124 rotating one or more suitably shaped, for example, somewhat elliptical or cardioid shaped, cams 126-a, 126-b, . . . 126-m. A follower 128-1, 128-2, . . . 128-n is coupled to each respective operating rod 122-1, 122-2, . . . 122-n. The respective followers 128-1, 128-2, . . . 128-n are coupled to each other in opposed pairs, 128-1, 128-2; 128-3, 128-4; . . . 128-(n - 1), 128-n by coil tension springs 130, so that they are continually urged against camming surfaces 132 of respective cams 126-a, 126-b, . . . 126-m. In this way, as one of the opposed sections 128-1; 128-3; . . . 128-(n - 1), reaches the end of its pumping stroke, the other of the opposed sections 128-2; 128-4; . . . 128-n reaches the beginning of its pumping stroke, thereby smoothing the flow of the pumped fluid.

Where there are multiple cams 126-a, 126-b, . . . 126-m, the cams 126-a, 126-b, . . . 126-m may also be oriented with their lobes at non-zero angles to each other. For example, if the cams 126-a, 126-b, . . . 126-m are somewhat elliptical, having lobes at the two opposite ends of their major axes, the major axes of the cams 126-a, 126-b, . . . 126-m may be oriented at non-zero angles to each other so that the pumping and priming strokes of each opposed pair 120-1, 120-2; 120-3, 120-4; . . . 120-(n - 1), 120-n of pump sections are out of phase with those of the other opposed pairs 120-1, 120-2; 120-3, 120-4; . . . 120-(n - 1), 120-n of pump sections. This arrangement further smooths the flow of the pumped fluid.

What is claimed is:

1. An assembly of fluid pumps, each pump including a movable component, a crank coupled to the movable component, at least two of the movable components defining between them a non-zero included angle.

2. The apparatus of claim 1 wherein the crank comprises at least two throws, the apparatus further including at least two connecting rods, the crank being coupled to the movable component by the at least two throws and the at least two connecting rods.

3. The apparatus of claim 2 wherein the at least two throws comprise at least three throws, one of the at least three throws defining substantially equal included angles with the other two of the at least three throws.

4. The apparatus of claim 3 wherein the at least three throws comprise n throws, n an integer greater than 2, each throw making included angles with two others of the n throws, each said included angle being about 360°/n.

5. The apparatus of claim 1 wherein the crank comprises a cam, the apparatus further including at least two followers, the crank being coupled to the movable component by the cam and the at least two followers.

6. The apparatus of claim 5 wherein the cam is configured to drive at least two of the pumps such that one of the at least two pumps reaches the beginning of an exhaust stroke at substantially the same time that the other of the at least two pumps reaches the beginning of a priming stroke.

7. The apparatus of claim 6 wherein the cam comprises m cams, m an integer greater than or equal to 2, each cam including p lobes, p an integer greater than or equal to 2, a line drawn between peaks of two adjacent lobes of one of the m cams making non-zero angles with lines drawn between peaks of any two adjacent lobes of another of the m cams.

8. The assembly of claim 1 wherein the pumps are coating material pumps.

Abstract of the Disclosure

A composite pump comprises multiple fluid pumps, each including a movable component and a crank coupled to the movable component. At least two of the movable components define between them a non-zero included angle.

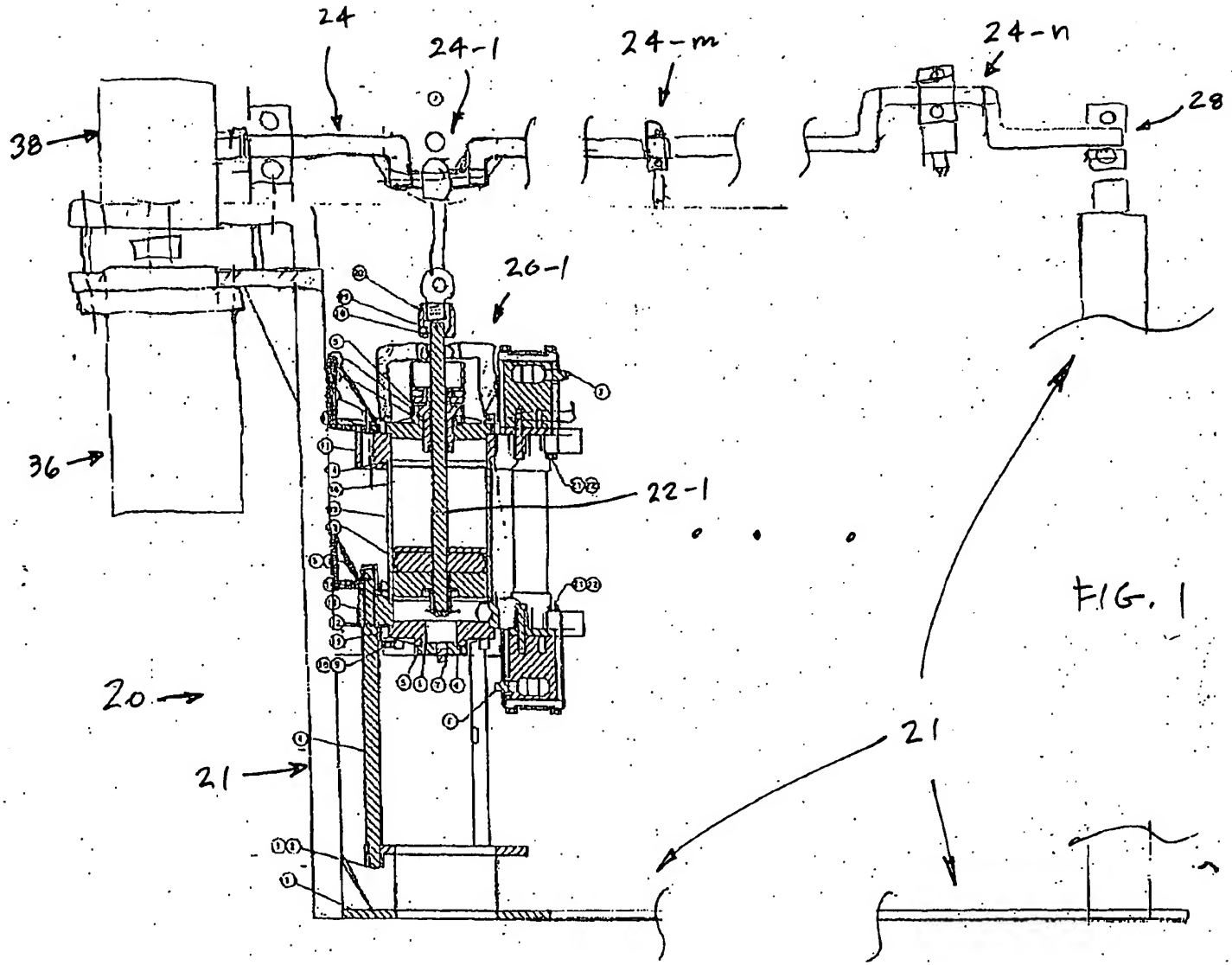

FIG. 1

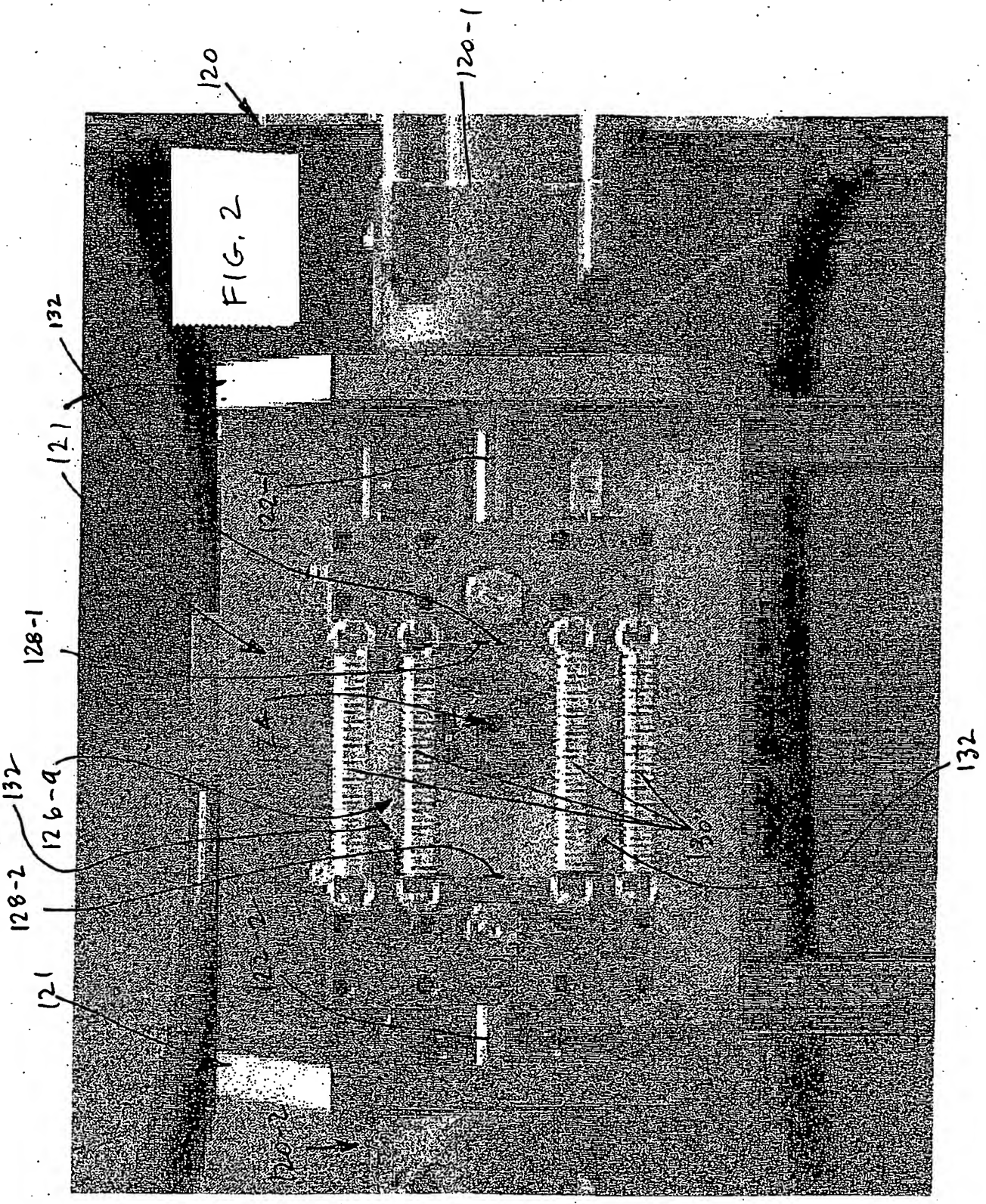

FIG. 2